5 Demand-Side Options: Energy Efficiency, Demand Response, Distributed Generation and Renewables

5.1 DSM, DG and Renewable Opportunities: Summary of General Findings

5.1.1 Energy Efficiency and Demand Response

The findings of the energy efficiency analysis are the following:

- Energy efficiency, demand response, distributed generation and renewables offer a significant hedge to volatile and rising energy prices and also contribute to achieving energy diversity.[1] A substantial amount of cost-effective electricity energy and demand reduction savings is possible.
- Total cumulative peak demand savings cumulative through to 2030 are
  - 591 MW in low-impact case
  - 811 MW in medium-impact case
  - 1,111 MW in high-impact case
- The cumulative electric energy savings through 2030 are
  - 2,314 GWh in the low-impact case
  - 2,924 GWh in the medium-impact case
  - 3,775 GWh in the high-impact case
- Cost of energy efficiency and demand management
  - The cost per kW-year for the demand savings ranges from \$17.28/kW-yr to \$207.25/kW-yr. See glossary for kw-yr definition
  - The cost per kWh for electric energy savings ranges from 0.26 to 16.80 cents/kWh
- Natural gas savings from through 2030 range from 533 to 1,998 thousand MMBtu.

5.1.2 DG and Renewable Resources

The findings of the DG and renewable resource analysis are the following:

- Untapped supplies of wind resources exist in the Mountains and Desert Regions of San Diego County and significant wind and geothermal potential remain in adjacent counties and in Northern Baja California, limited primarily by sufficient transmission.
- Depending on the scenario, from 10- to 25-percent potential of DG and renewable resources exist. The actual potential depends on current and improved operating efficiencies of the technology, as well as electricity price and capital cost trends of the equipment. Approximately 2,150 to 3,260 MW of DG and renewable energy could be available between now and 2030.
- The legislature has passed a law that requires utilities to purchase one percent more renewables per year, up to 20-percent renewables by 2015.
- CHP, wind, PV and geothermal represent the largest distributed resources applications potential over the study period.

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[1] *Energy efficiency* is defined as a net reduction of energy required to meet a specific load. *Demand reduction* is a lowering of a portion of the load curve from the base load. *Demand response programs* include market driven and economy/emergency reductions in loads at specified time periods. *Demand-side management* is a term used to refer to the full set of efficiency, demand response and load reduction efforts by an individual customer, group of customers, utility initiated or third party. In modeling program cost effectiveness, programs were evaluated separately for their energy and demand impacts and energy and capacity values (or avoided costs) were used for each year of the analysis using the COMPASS model.

- Wind and photovoltaics (PV) can constitute a substantial amount of renewable energy potential in the region with continued incentive support and innovative purchasing strategies such as aggregation in the near-term, followed by cost reductions through manufacturing improvements in the longer-term. Untapped opportunities exist to support indigenous renewables such as PV (e.g., SDREO/SDG&E-sponsored green power purchasing program to support renewables requirement similar to that which has been pursued at LADWP, SMUD and other metropolitan areas throughout the country). Future resource potential depends on capital cost reductions and incentives.
- San Diego currently has 527 DG sites with a combined capacity of 372.3 MW—or 8 percent of current peak demand. Natural gas fueled combined heat and power (CHP) systems represent the largest percentage of DG capacity at 327 MW, followed by landfill gas (13.8 MW), hydro (9.8 MW) and photovoltaics (1.5 MW). 1 MW of PV produces about 200 KW per hour – annually, noted the City of San Diego, CA.
- A stakeholder-based Distributed Generation Task Force was recently formed to a) assist in forming policy recommendations to support the Regional Energy Strategy, b) to evaluate and refine the findings of this study to develop future programs that maximize utilization of distributed generation and renewables public-good funding to achieve regional goals, c) review progress and incorporate findings and recommendations into an annual report to the public, and d) to develop and encourage financing mechanisms to assist in the development of DG.

5.1.3 Short Term (2002-2006)

- Energy efficiency, demand response, DG, and renewable resource acquisition plans need to be developed
- Aggressive monitoring and evaluation tools of measure performance are needed
- A collaborative strategy to merge energy efficiency with clean air, renewable and homeland security funds should be developed, because there are important synergies among these programs
- Packaged standardized solutions consisting of energy efficient, demand reduction, DG and renewable technologies should be developed and target marketed for selected business and institutional sectors
- An annual evaluation plan should be reported to the public on the performance of the region's demand side and renewable efforts. Strong community feedback on the performance of programs should be reported. A formal cost-benefit report on the region's energy efficiency, DG and renewable efforts should be reported to the public
- Energy efficiency programs should be tied to regional development efforts and economic development of new business and industries
- The region needs to communicate to businesses and energy companies the "option value" of energy efficiency, demand response, DG and other measures. A strong communication plan should be developed to provide the public and industry feedback on the relative success of programs and impact on alleviating additional supply requirements
- The region needs to consider the need for a DG portfolio in addition to a renewable portfolio that the state recently approved.
- CEC is responsible for setting building standards. The region should partner with the CEC to evaluate building standards to incorporate higher efficiency equipment.

5.1.4 Mid Term (2006-2010)

- Continue to monitor program performance and report results to the public
- Track economic development efforts and income to the community from the region's jobs and businesses developed which program energy efficiency, renewable and DG options
- Work to change the portfolio of energy efficiency and DG options as avoided costs change and as new technologies are added

- More target marketing of DG and other resources will be required. The regional energy development authority should consider additional financing opportunities for clean and green energy technologies
- Much more emphasis on demand response, automation, and dynamic or time-differentiated pricing may be necessary
- Demand responses tied to congestion and reliability issues may expand depending on load growth and congestion on the transmission system
- Increased automation of energy technologies with grid management may occur
- Expanded energy efficiency and demand response options in North Baja should be encouraged working in parallel with appropriate organizations to improve the emission impacts from the substantial electric generation that is expected.

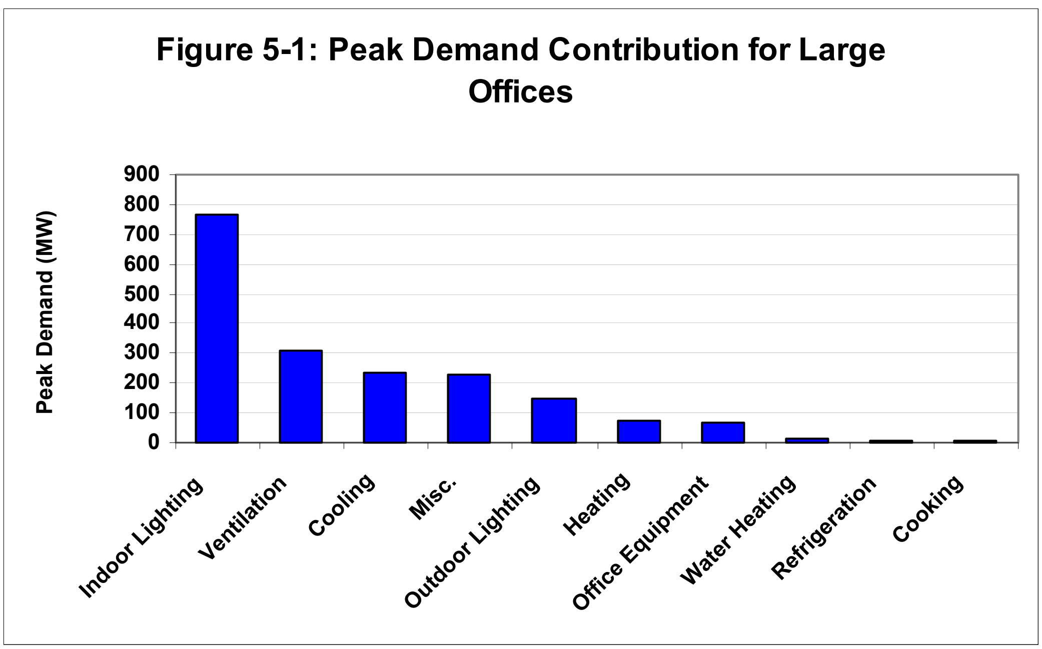
5.1.5 Post-2010 Time Period

- Significant expansion of wind and photovoltaic resources is expected during this period due to a reduction in capital cost and improved performance.

5.2 Background

5.2.1 Energy Efficiency

The San Diego region demonstrated in the summer of 2001 that as much as 2.2 percent or 81.7 MW of the region's peak load requirements were met through pricing, customer education, and demand response programs. Figure 5-1 shows the major elements that comprise the peak demand for large commercial office buildings. The figure suggests that programs which target peak electric demand reduction (e.g., air-conditioning use, commercial lighting and other miscellaneous commercial loads) may be more cost effective because of the higher avoided costs that occur during the peak periods.



Source: California Energy Commission.

Major questions that need to be addressed are:

- How much additional cost-effective demand reduction and energy efficiency potential remains in the county?
- What is the "optimal" investment level?
- Where should the resources be located?

This report provides answers to some of these questions. Additional research, analysis, community discussion, and public policy support will be needed to resolve selected issues. In the past, investment decisions in energy efficiency and demand reduction have been somewhat limited to CPUC proceedings and utility management. Potential opportunities include advanced pricing (time-of-use pricing and real-time pricing), automatic and/or web-based metering methods, and energy management and automation systems including smart appliances that can vary their coincident use based on market conditions, as well as many other conservation and demand reduction strategies. Many of these measures are currently supported by public-good funding.

The following approach was taken to estimate the potential for energy efficiency and demand response:

1. Review prior studies and reports on previous energy efficiency and demand response programs.
2. Identify and screen applicable programs and their success in other markets.
3. Identify key program data and assumptions for programs, including energy savings, expected customer acceptance, program costs, and market penetration.
4. Enter data into the COMPASS[2] model for analysis.
5. Complete iterative analyses.

The result of the analysis provides SDREO with all the core data and results in a single relational database for future analysis. The benefit-cost analysis is consistent with the earlier developed California Standard Practice Methodology, and the assumptions, input data and program results from past year's programs can be used to update the modeling and analysis for year-to-year program planning.

5.2.2 Public-Good Energy Efficiency Programs

San Diego Gas & Electric and other third parties, like the San Diego Regional Energy Office and the City of San Diego, are currently offering a broad range of energy efficiency programs that provide incentives to encourage the purchase of energy efficient equipment and support practices for the design and construction of energy efficient buildings and homes. In September 2000, Governor Davis signed two bills—AB995 and SB1194—extending the systems benefits charge on electric distribution service to support these programs with $35 million in annual funding for energy efficiency programs through 2012.[3] Currently, the CPUC is piloting the use of third parties to help implement energy efficiency and load management programs under AB 1890.

5.2.3 Distributed Generation (DG) and Renewable Programs

Grid-based power and centralized electric power plants will continue to be the major power supply source for the San Diego region in the foreseeable future. However, DG applications can complement central power by providing cost-effective incremental capacity to the utility grid or to an end user.

The Gas Research Institute (GRI) estimates that DG for systems of 25 MW and under will grow an average of 4 percent per year from 2001 to 2015.[4,5] DOE/EIA projects that utility DG resources

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[2] Comprehensive Planning and Analysis System, owned by Silicon Energy and licensed to SAIC for this project.

[3] The CPUC is piloting and moving in the direction of allowing more non-utility administrators implementing energy efficiency and DG programs. SDREO is the major non-utility administrator of programs in the San Diego region.

[4] http://www.industrialcenter.org/consortia/distribgen.htm. A wide variety of ranges in estimates are reported depending on the definition of technologies and markets. According to Resource Dynamics, there is a base of about 50 GW of smaller reciprocating engines. It is reported that less than 100 MW of capacity each year is sold by microturbines, fuel cells and other DG renewables. It is estimated that as much as 72 GW of DG may be added by 2010. See: http://www.distributed-generation.com/market_forecasts.htm#Potential%20DG%20Market%20Size.

between 2000 and 2020 will represent about 5 percent of total capacity or 19.1 GW of capacity added by 2020. DOE/EIA estimates that DG in buildings will grow from 8 billion kWh in 2000 to 27 billion kWh in 2020 for all fuel uses.[6] Aggressive state and federal incentives offered for renewable and other clean DG resources are now supported by the State of California's recently passed SB 532 that increases production of renewable energy from 12 percent of the state's electric supply to 20 percent by 2010.

San Diego has 527 DG sites with a combined capacity of 372.3 MW—or about 8 percent of current peak demand. Combined heat and power (CHP) systems represent the largest percentage of DG capacity at 327 MW, followed by landfill gas (13.8 MW), hydro (9.8 MW) and photovoltaics (1.5 MW).

This study projects that a total of 2,200 to 3,200 MWs of DG and renewable capacity could be installed by 2030. This would represent approximately 30 percent of projected peak electrical demand for the region in 2030.[7]

DG can also benefit electric utilities and ratepayers by avoiding or reducing the cost of transmission and distribution system improvements, avoiding congestion problems, adding voltage support, providing more efficient use of natural gas (through CHP), reducing peaking and base load generation development requirements, and provide additional generation without the capital cost being passed on to consumers. The individual customer could benefit from increased reliability, reduced peak demand and the ability to chose a power supply in the absence of direct access. Broader regional benefits from DG include: power supply diversity, increased in-region power supply, DG as a hedge against high grid-based power supply options, and energy security through enhanced "control" of supply and economic development.

Increased use of DG technologies in the region also has several potential disadvantages including the need for gas and T&D infrastructure upgrades, increased complexity of coordination of DG units for grid planning, inability of many DG technologies to dispatch power on demand and the potential of over reliance on natural gas.

Several economic, regulatory and institutional barriers exist that will influence the rate at which DG penetrates the San Diego region. Perhaps the most significant barrier to widespread deployment of DG is the high up-front capital cost of many technologies. While some DG technologies are very cost effective (e.g., CHP), others currently depend on government incentives (e.g. PV, wind, geothermal and natural gas DG, and some biogas DG). Regulatory barriers include tariff configuration, costly system exit fees and permitting processes, reasonable standby changes, predictable and reasonable prices for all of electricity sold to the grid, and better scheduling arrangements for excess power.

The extent to which DG contributes to the San Diego region's energy future depends largely on the cost of energy, technological advances, the degree to which environmental externalities are valued (e.g., impact of emissions) and removal of critical barriers through regulatory and/or legislative decisions.

5.3 Key Energy Efficiency and Demand Reduction Programs

Key programs and technologies that can create significant energy and demand savings include:

- Residential
  - Retrofit program for existing homes[8]

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[7] Premium power uses, standby emergency generation and combined heat and power are assumed to be the largest uses for DG. GRI estimates that about 30 GW of natural gas fired DG will be on line by 2015. A vast majority of this will be gas turbine equipment.

[8] DOE/EIA, See: http://www.eia.doe.gov/oiaf/speeches/dist_generation.html.

[7] As SDG&E points out, this is a very ambitious estimate. Also, the cost and resource value of this estimate needs to be reviewed in light of the CDWR contracts and the CPUC promulgated cost allocations to customers. CPUC sanctioned customer exit fees also need to be considered.

- Title 24 Plus for New Construction
- Photovoltaics for both new and existing homes
- Advanced metering and control (for larger users)
- Condition-of-building sale

▪ Commercial and industrial (C&I)

- Demand Flexibility
- High efficiency motors
- High efficiency lighting
- Retrofit Program
- E2PRO: Energy and Environment Program.[9]

These programs were modeled for their energy and/or demand savings using the COMPASS model. The "value" of these programs is driven by the avoided energy and capacity costs, as well as the reduced transmission and distribution expenses. COMPASS models the impacts of each measure and rolls up the demand and energy savings, plus cost, into a bundled program. Appendix G presents this methodology in greater detail.

As shown in Table 5-1, three avoided cost scenarios were used. They were tied to the cost of natural gas, and the higher discount rate for building new plants in California. Each program was evaluated for cost-effectiveness from the program participant's perspective, and from the total resource cost (TRC) perspective. Programs were valued for their demand and energy savings by individual measure. Multiple measures comprised bundled programs. Different ramp up rates and penetration levels were estimated by scenario. The lower the growth rate and avoided cost, the lower the penetration and ramp up rates. The higher the growth and marginal costs, the higher the penetration and ramp up rates.

The results of the analysis for these programs are summarized in Tables 5-1 and 5-2 and Figures 5-2 and 5-3.

Table 5-1. Summary of Demand and Energy Impacts of Energy Efficiency and Demand Response Programs

Conservation & Load Mgmt	LOW	MEDIUM	HIGH
Summer Demand Impact, MW			
2006	110	145	194
2010	233	290	368
2020	414	553	745
2030	591	811	1,111
Energy Savings, GWH			
2006	373	538	771
2010	833	1,053	1,360
2020	1,704	2,117	2,696
2030	2,314	2,924	3,775
Gas Savings, thousand mmBtu			
2006	290	350	463
2010	566	723	1,128
2020	582	889	1,810
2030	533	904	1,998

Source: SAIC Analysis

[8] Retrofit includes water heater blankets, night setback thermostats, insulating glass window replacements, and home insulation.
[9] For a definition of the actual measures that are included in each of the programs, see Appendix C.

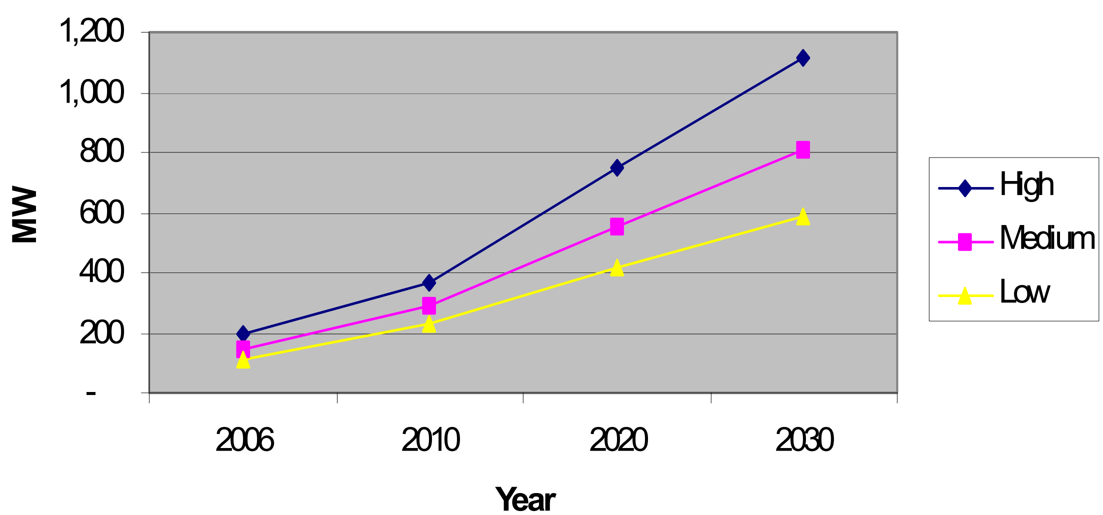
Table 5-2. Summary of DSM Program Life Cycle Costs and Impacts[10]

Program	Program	Program Life Cycle Costs, ¢/kWh	Year 2030 Energy Savings GWh	Year 2030 Energy GWH Cumulative Savings
Residential Condition of Sale	RCS	-	359	359
C&I Retrofit	CRT	0.26	1,401	1,760
C&I E2 Program	CE2	0.30	547	2,307
Residential Retrofit	RRT	1.58	207	2,514
C&I Demand Response	CDR	7.97	310	2,824
Residential Title 24 Plus	R24	9.50	34	2,858
Residential Advanced Metering	RAM	16.80	66	2,924

Program	Program	Program Capital Costs, $/kW-Yr	Year 2030 Summer MW Savings	Year 2030 Summer MW Cumulative Savings
C&I E2 Program	CE2	17.28	93	93
C&I Retrofit	CRT	18.01	174	267
Residential Condition of Sale	RCS	19.03	198	465
Residential Advanced Metering	RAM	121.23	91	556
C&I Demand Response	CDR	133.20	185	741
Residential Title 24 Plus	R24	172.04	19	760
Residential Retrofit	RRT	207.25	51	811

Source: SAIC Analysis.

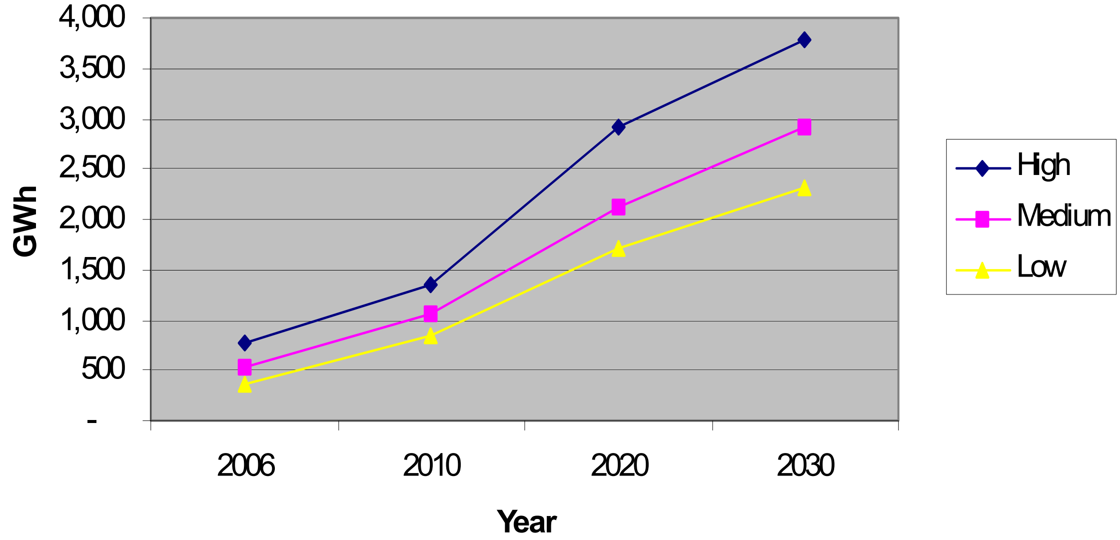
Figure 5-2. Demand Impacts of Programs, 2006–2030 (in MW)



Source: SAIC Analysis.

[10] See Appendix G for a review of the modeling and key assumptions, more detailed features of the program designs.

Figure 5-3. Energy Savings Impacts of Programs, 2006–2030 (in GWh)



Source: SAIC Analysis

5.3.1 Results: Market Impacts and Cost Effectiveness

Figures 5-2 and 5-3 show the range of demand and energy savings by scenario, respectively. The demand impacts from the energy efficiency and demand response programs are:

- Savings in the low-high scenarios may range from 591 MW in the low case, to 811 in the medium case and 1,111 in the high case by 2030.
- Program energy savings range from 2,314 to 3,775 GWh by 2030. (See Table 5-1.)
- Residential and commercial photovoltaics and C&I retrofits provide the greatest savings (1,401 GWh) at cost ($0.26 /kWh). See Table 5-2.
- All but three measures have low costs on a $/kW-yr basis.
- Nearly all DSM options are cost effective when compared to the total delivered cost of energy to customers, assuming average retail prices are from $.14 to $.17 per kWh
- The programs vary in their ability to reduce demand and energy consumption. Some programs are stronger at energy savings and others are stronger performers for demand savings.
- The largest demand reduction programs, which contain multiple measures, include residential condition of sales, C&I retrofit, and C&I demand response.
- The programs with the largest energy savings in the Year 2030 are C&I retrofit, and C&I E-2 program.
- C&I programs offer the most significant energy savings at the lowest capital costs. This program should be the highest priority for implementation.
- Capital costs in present dollars for all program initiatives do not exceed $207.25/kW (Table 5-2).

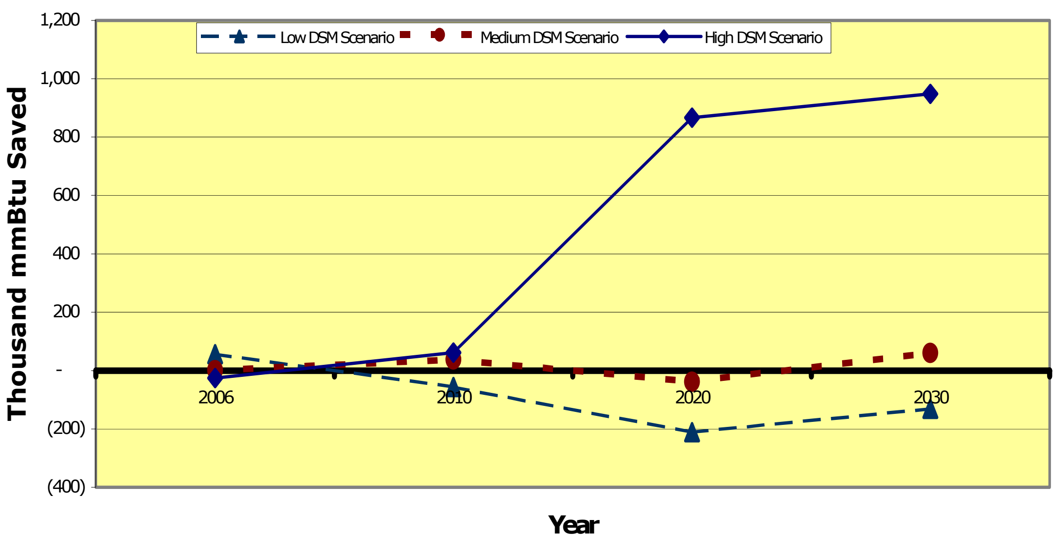
Program expenditures range from $316 million to $850 million over the 30-year time period.[11]

- Advanced Metering and Control for the residential market show very high energy life cycle costs because they save little energy and demand. This suggests narrowing the focus of program implementation for higher use customers.
- Residential Retrofit Program is also very cost effective from an energy savings standpoint.

The estimated savings from the natural gas demand management programs are as follows (See Figure 5-4):

- Natural gas savings show a net increase in the low DSM scenario due to higher incremental gas sales from DG. The medium scenario show incremental gas consumption even with off-setting incremental gas sales with conservation. In the aggressive, high DSM case, gas savings occur due to the cumulative gas savings potential over the extended time period. Conservation savings from growth exceed incremental DG sales.
- Approximately 1 Billion BTU of natural gas can be saved over the next 30 years in the high DSM scenario. This is a modest amount of gas due to the relatively low customer use of gas for residential and commercial applications. This is through more efficient buildings, furnaces, boilers, and hot water heaters. Increased pipe insulation, efficient dishwashers and flow restrictors also contribute.

Figure 5-4. Natural Gas Savings Impact of DSM Program Scenarios



Source: SAIC Analysis

5.3.2 Environmental Impacts

Table 5-3 lists the emissions impacts of the electric efficiency and demand response programs based on 1998 average emission levels.[12]

[11] At current expenditure levels, approximately $350 million in public funding will be expended through 2012 for energy efficiency programs in San Diego. If these programs are continued beyond 2012 at the same funding level, an additional $630 million will be available for energy efficiency through 2030. An additional $62 million in public incentive will be allocated through 2004 for self-generation.

[12] Emissions reductions are estimated using the following: NOx: 7.0 lb/MWh; SO2: 7.9 lb/MWh; PM-10: 23.09 lb/MWh: CO2: 1,408 lb/MWh.

Table 5-3. Emission Impacts of Demand Response Programs

Emissions Reduction, million lbs	Low	Medium	High
Year 2006			
NOx	2.61	3.77	5.40
SO2	2.95	4.25	6.09
PM-10	8.61	12.42	17.80
CO2	526	758	1,086
Year 2010			
NOx	5.83	7.37	9.52
SO2	6.58	8.32	10.75
PM-10	19.23	24.31	31.40
CO2	1,173	1,482	1,915
Year 2020			
NOx	5.85	7.26	9.25
SO2	13.46	16.72	21.30
PM-10	39.35	48.88	62.25
CO2	2,399	2,981	3.796
Year 2030			
NOx	16.20	20.47	26.43
SO2	18.28	23.10	29.82
PM-10	53.43	67.52	87.16
CO2	3,258	4,117	5,315

5.4 DG Technologies

The CEC defines DG as "generation, storage, or demand-side management devices, measures, and/or technologies connected to the distribution level of the transportation and distribution grid, usually located at or near the intended place of use."[13]

The intention of this section is not to provide an exhaustive review of distributed generation technologies and assumes the reader has a working knowledge of the subject. Instead, this section focuses on evaluating the current status of DG in the region and the potential future role it might play in regional energy planning.

5.4.1 DG Technology Comparison

There are many DG technologies that vary by first cost, efficiency, capacity, operation and maintenance costs, fuel type and commercial availability. This section focuses on the possible role of microturbines, internal combustion engines, combined heat and power (CHP) applications, fuel cells, photovoltaics and other solar energy systems, wind, landfill gas, digester gas and geothermal power generation technologies to help meet the growing power needs of the San Diego region.

Table 5-4 compares various characteristics of selected DG technologies.

5.4.2 Framework for Evaluating Role of DG

Evaluating the role of DG technologies in the energy future of the San Diego region will involve many perspectives. Each perspective ascribes different values to DG. Considering and balancing these perspectives is essential in determining the value of DG for the region. Natural tensions will arise between individual customer perspective, which is more focused on immediate energy cost savings, versus a regional perspective, which may see DG as a means of providing energy market stability and broader societal benefits, such as supply diversity, control and security.

[13] Distributed Generation Strategic Plan, Draft Committee Report. California Energy Commission. May 2002.

Table 5-4. Comparison of DG Technologies[14]

Factors	Microturbines	Combustion Turbines	Reciprocating Engines	Fuel Cell	Wind	Photo-voltaics
Cost ($/kW)	$300–$1,000/kW	$300–$1,000/kW	$300–$900/kW	$5,500–$12,000/kW	$1,000/kW	$6,000–$10,000/kW
Commercially Available	Yes	Yes	Yes	Only PAFC*	Yes	Yes
Size Range	30–500 kW	500 kW–25 MW	5 kW–7 MW	1 kW–10 MW	Several kW–5 MW	<1 kW–1 MW+
Fuel	Natural gas, hydrogen, propane, diesel	Natural gas, liquid fuels	Natural gas, diesel, landfill gas, digester gas	Most Fuel Types	Wind	Sunlight
Efficiency	20–30% up to 85% in CHP	20–45% (primarily size dependent)	25–45%	30–60%	20–40%	5–15%
Emissions	Low (<9–50 ppm) NOx	Very low when controls are used	Emission controls required for NOx and CO	Nearly zero emissions	No emissions	No emissions
Combined Heat and Power (Cogeneration)	Yes	Yes	Yes	Yes	N/A	N/A
Commercial Status	Small volume production	Widely available	Widely available	PAFC* Available	Widely available	Widely available

Source: California Energy Commission.
*PAFC denotes Phosphoric Acid Fuel Cell.

The following represents the various perspectives that should be considered when evaluating the role DG can play in the San Diego region's energy planning future.

- **Customer** (Commercial, Industrial, Residential) – Individual customers typically value energy cost savings, reliability, and control of supply, government incentives and environmental benefits.
- **Region** – From a regional perspective, the value of DG includes energy supply adequacy, control and security, energy planning flexibility, environmental benefits and economic development opportunities.
- **Utility** – DG represents a mechanism for utilities to mitigate system congestion, maintain T&D system efficiencies, and support stressed portions of the system (e.g., high demand at the end of a distribution line).

5.4.3 DG Applications

The varying perspectives outlined above will be driven by the range of DG applications relevant to each. Distributed generation technologies can be used in many different applications that can directly affect a customer site and more broadly affect the electrical transmission and distribution system.

5.4.4 Customer-Based DG

According to the California Energy Commission,[15] the primary customer-based applications for DG include:

- **Combined Heat and Power (CHP)** – CHP, sometimes-called cogeneration, uses waste heat recovery equipment in conjunction with DG power generation equipment (e.g., reciprocating

[14] These are only equipment cost averages, not fully loaded installed costs, which may vary for each individual facility.
[15] See http://www.energy.ca.gov/distgen/background/background.html

engine, microturbine, fuel cell, etc) to capture and use waste heat. CHP applications vastly increase the efficiency of on-site power generation.

- **Power Quality/ Premium Power** – Commercial and industrial customers are using DG technologies to reduce frequency variations and to control voltage transients, surges, dips or other disruptions.
- **Peak Shaving** – DG can be used during peak demand times when electricity prices and demand charges are highest.
- **Low-Cost Energy** – DG can be used as baseload (primary) power source that is less expensive to produce locally than it is to purchase from the electric utility.
- **Stand Alone** – for energy needs in remote locations, DG that is isolated from the grid may be more economical than building new transmission and distribution infrastructure (although this Study does not specifically address stand-alone potential and applications, which are usually extremely cost-effective if any significant amount of grid infrastructure extensions are required (more than one quarter to one-half mile).
- **Standby Power** – DG may be used in the event of an outage to provide back-up to the electric grid, when designed to perform this function.

5.4.5 System-Based DG

Applications that affect the transmission and distribution system and the broader energy market include:

- **Managing T&D Constraints** – DG technologies are used to reduce load in specific locations of the utility transmission and distribution grid.
- **Improving T&D System Efficiency** – By increasing the number of DG generators connected to the grid, more customers can be served with the existing infrastructure. In addition, DG can be located closer to load pockets, reducing the need for unnecessary transmission and distribution infrastructure.
- **Targeted, Incremental Capacity Additions** – DG technologies provide the flexibility to add smaller, incremental additions to the grid system that better match the demand growth in a particular segment of the grid.
- **Market Improvement** – Increasing the number of power suppliers can decrease the potential for the type of market power exerted during 2000–2001 in California.

5.5 Distributed Generation Market Overview

In the past, the San Diego region has had success with DG technologies and was a leader in Qualifying Facility installations in the early 80s. The region is currently experiencing moderate-to-high market penetration of DG technologies due to high prices for electricity. For the last decade, industry experts have outlined the benefits of a transition from centralized power system, in which large power stations generate power that is delivered to customers via the transmission and distribution infrastructure, to a more distributed model, in which customer produce all or a portion of their power needs at their facility. This transition is tantamount to the transition of the computer industry from mainframe to personal desktop computers. A number of factors are driving this trend including energy security, increased energy prices, increased difficulty siting larger infrastructure and technological advances and improved efficiencies.

Since the September 11 terrorist attacks, there has been an increased emphasis on energy security. Large centralized power plants and supply lines can be vulnerable to attack and sabotage. Because of its decentralized nature, DG is less susceptible to disruption. In addition, increased energy prices during 2000–2001 led all customer classes to consider DG. Finally, technology is driving increased efficiencies. Traditionally, cost and electrical efficiencies were gained by the economies of scale of large-scale base load power plants. Today, smaller systems, particularly those that capture and utilize waste heat, can achieve more than double the efficiency of larger power plants.

5.5.1 Inventory of DG in San Diego Region

The San Diego region currently has 527 DG sites for a total capacity of 372.3 MW of DG capacity. Table 5-5 indicates the total number of sites and capacity for the DG technologies in use. In subsequent tables, further detail is provided on each technology including the current level of market penetration, the potential for market expansion and a summary of how the technology should be viewed in the larger context of regional energy planning.

Table 5-5. DG Capacity in San Diego County (2002)

Technology	Number of Systems	Capacity (MW)
CHP	50	327.2
Bio Gas	11	30.3
Hydro	6	6.7
Steam Turbine	2	6.6
PV	452	1.6
Wind	6	.0085
Total	527	372.3

Source: SDG&E, EPA, and SDREO.

5.5.1.1 Combined Heat and Power Plants (CHP)

The average power plant loses more than two-thirds of the energy content of the input fuel in the form of heat. CHP systems capture and use that heat to generate both thermal and electrical energy. "CHP," also called cogeneration, can significantly increase the efficiency of energy utilization, reduce emissions of criteria pollutants and CO_2, and lower operating costs for industrial, commercial and institutional users."[16]

San Diego County currently has 50 combined heat and power plants, representing about 327.2 MW of capacity. Table 5-6 lists the sites by technology type.

Table 5-6. CHP by Technology

Technology	Number of Systems	Capacity (KW)
Reciprocating Engines	26	20,428
Microturbines	8	730
Combined Cycle	4	157,300
Gas Turbines	12	148,733
Total	50	327,191

Source: CEC

5.5.1.2 Potential for CHP

A total of 12,108 MW of remaining CHP potential was identified for California split fairly evenly between the industrial and commercial sectors,[17] and represents approximately 726 MW for San Diego.

[16] Market Assessment of Combined Heat and Power in the State of California, California Energy Commission. December 1999.

[17] Market Assessment of Combined Heat and Power in the State of California, California Energy Commission. December 1999.

Table 5-7 provides an estimate of the remaining CHP potential in the commercial and industrial market. The table shows that smaller CHP systems of 1 MW and less represent the largest market in the future for the commercial market. Larger systems of one or more megawatts are in higher proportion for the industrial market.

Table 5-7. Estimated Remaining CHP Potential in the C&I Market, San Diego[18]

Size Category	Commercial		Industrial		*Total*	
	Sites	**MW**	**Sites**	**MW**	***Sites***	***MW***
50–250 kW	1,414	126	n.a.	n.a.	***1,414***	***126***
250–1,000 kW	158	86	77	39	***235***	***125***
1–5 MW	32	60	35	71	***67***	***131***
5–20 MW	4	27	6	63	***10***	***90***
>20 MW	1	37	3	217	***4***	***254***
Total	1,609	336	121	390	***1,730***	***726***

Source: CEC

In the industrial sector, the applications are concentrated in the petroleum, food processing, pulp and paper, and wood processing industries. In the commercial sector, the applications are concentrated in data centers, telecommunications, high tech applications, pharmaceuticals, biotechnology, education, restaurants, lodging, and apartment buildings. For this reason, the absolute market potential for DG may be limited and potentially lower than SAIC's estimates, noted SDG&E in its review of the draft REIS.

5.5.1.3 Summary: CHP

Combined heat and power applications, including microturbines, reciprocating engines, fuel cells and gas turbines will make up the highest capacity of any DG technology in the region.

5.5.2 Landfill Gas

The largest increase in renewable energy nationally is expected to come from biomass energy. Biomass energy sources are estimated to almost double from 36.6 to 65.7 BkWh by 2020 for the US. An estimated 16.4 billion kWh of electricity could be generated using renewable biomass fuels in California. A profile of selected landfill sites appears in Table 5-8.

Electricity generation from municipal solid waste and the use of landfill gas is expected to increase by 15.9 Billion kWh from 1999 to 2020. The national forecast estimates no new plants that burn solid waste would be added. However, plants that burn landfill gas capacity are projected to grow by 2.1 GW.

The San Diego region has 7 operational landfill gas generation plants.[19] Table 5-8 outlines the primary characteristics of these power plants. Other digester gas generation exists at the Encina WWTP, Escondido Hale Ave., the Cardiff WWTP and an additional unit is currently planned for Oceanside.

[18] Estimates represent 6 percent of the total CA market potential in the *Market Assessment of Combined Heat and Power in the State of California* report.
[19] EPA, Landfill Gas-to-Energy (LFGTE) Project Opportunities: Landfill Profiles for the State of California, EPA 430-K-99-004, January 1999.

Table 5-8. Existing Landfill and Wastewater Gas-fired Generator

Features	Miramar SLF Phase I	Miramar SLF Phase II	Jamacha LF	Pt. Loma Waste-water Plant	San Marcos LF	South Chollas LF	Sycamore LF
Estimated Methane Generation (mmscf/day)	6.12	6.12	0.26	NA	4.61	0.95	2.76
Current Landfill Gas Collected (mmscf/day)	6.5	N/A	N/A	NA	1	1.1	1
Generation System Type	Cogen	Recip Engine	Gas Turbine	Cogen Recip	Gas Turbine	Recip Engine	Recip Engine
Started Generating (year)	1997	1999	2002	1985	1989	2000	1989
Electricity Sold to (utility)	SDG&E	SDG&E	SDG&E	SDG&E	SDG&E	SDG&E	SDG&E
Current Capacity (MW)	6.4	3.8	0.28	4.57–5.77	1.3	N/A	1.4
Estimated Potential Capacity (MW)	19	19	N/A	8.0	14	3	9

Source: EPA, Landfill Gas-to-Energy (LFGTE) Project Opportunities: Landfill Profiles for the State of California, EPA 430-K-99-004, January 1999.

Note: Estimated capacities may require significant expansions of existing facilities.

5.5.2.1 Potential for Landfill Gas

As noted above, two candidate sites were identified as providing a potential new source of landfill gas: Ramona at 0.07 mmscf/day and South Chollas (No. 2) at 0.95 mmscf/day. For these sites to be considered candidates, they must have at least 1 million tons of municipal solid waste (MSW) available for producing landfill gas.

The City of San Diego's Point Loma Waste Water Treatment Plan currently has an additional 2.5 to 3.5 MW of digester gas-fueled generation of which 1.2 MW is now being developed utilizing a diesel as a dual fuel digester gas peaking facility.[20]

Additionally, the City of San Diego could possibility generate up to 4.6 MW today at Loma Linda landfill and another 1.3 MW at another facility. The City has not pursued these projects due to restrictions that do not allow customers to supply their own generation. For example, excess generation from the Pt. Loma Waste Water Treatment Plant could supply the City's largest single load of nearly 8 MW, which is Pump Station #2, just a few short miles from the generation source. Instead, the City must sell excess power from generation sites at prices tied to lower avoided costs (approximately 2 to 3 cents per kWh), then purchase power from SDG&E at other sites at higher standard commercial rates (approximately 12 to 14 cents per kWh). This is a tremendous disincentive for the City to develop this beneficial renewable resource. The City has a goal of supplying up to 15 percent of its energy requirements from DG, including backup power protection for police, fire, and pool heating and hospital plant protection.

[20] Conversation with Tom Alspaugh, City of San Diego Metropolitan Wastewater Department, May 21, 2002.

5.5.2.2 Summary: Landfill

Landfill gas, comprising both landfill gas and solid waste separation and incineration, represents good potential options. State-of-the-art incineration systems are working in Europe as part of residential developments, generating heat and power. The City of San Diego has significant potential to produce landfill energy sources through landfill gas and incineration energy. Greater cooperation is encouraged between SDG&E and the City to create positive incentives to encourage the development of these resources for the good of the region. The City and the County are currently investigating measures to expand landfill possibilities. Current retail wheeling restrictions limit the possible expansion of landfill-gas fired power generation facilities. Serious consideration should be given to increasing the total share of energy from landfill sites, using various technologies. Landfill energy has the potential of providing up to 100 MW of local electric demand capability by 2030.

5.5.3 Hydro Power

While San Diego does not have sufficient indigenous water resources to produce significant hydro generation, limited hydro is available through applications in the water and wastewater public sectors. Currently the region has 8.32 MW of hydro-generated power plants.[21] (See Table 5-9).

Table 5-9. Hydro Facilities in the San Diego Region

Facility Name	Capacity (MW)	Date On Line	System Owner
Alvarado Hydro Facility	1.99	04/30/1985	San Diego County Water Authority
Badger Filtration	1.48	07/08/1987	San Diequito Water District
Bear Valley	1.60	03/15/1986	City of Escondido
Miramar Hydro Facility	0.80	04/15/1985	San Diego County Water Authority
Olivenhain Municipal Water District	0.45	09/30/1988	Olivenhain Municipal Water District
Point Loma	1.35	09/01/1984	City Of San Diego
Rincon Hydro	0.30	06/08/1983	City Of Escondido
San Francisco Peak Hydro	0.35	12/15/1985	City Of Oceanside
TOTAL	**8.32**		

Source: CEC Powerplant Database and SDG&E.

5.5.3.1 Hydro Potential

The County Water Authority is currently planning to build a 40 to 90 MW pumped storage facility at the Olivenhain/Lake Hodges site. If built, this facility would add to the current pumped-storage capacity of 3,630 MW at seven other plants throughout the State of California. While they are net consumers of energy, their output for meeting peak demand is very reliable. By pumping uphill during the night and producing electricity during the peak hours, these plants flatten the daily load curve; therefore, they serve to increase system-wide economy by using energy from baseload plants that are most efficient when run continuously and reducing the need for peaking plants during the day.

5.5.3.2 Summary: Hydro Power

Hydropower will likely remain a small percentage of total regional power supply. To increase power supply diversity and in-region generation, the region should continue to explore all cost-effective hydro opportunities.

5.5.4 Photovoltaics

There is significant growth of PV in San Diego County. Currently, there are 445 PV projects and 5 PV/Wind hybrid projects in San Diego County representing about 1.6 MW[22] of power generation. Additionally, another 117 projects totaling 2.1 MW have completed interconnection agreements with

[21] CEC Power Plant Database. See http://www.energy.ca.gov/database/index.html#powerplants.
[22] San Diego Gas and Electric Net Metered Spreadsheet provided by Bob Keithly.

SDG&E but have not been permitted. San Diego has among the best solar resources in the nation. According to the National Renewable Energy Laboratory, San Diego receives an average of 5.7 usable hours of peak sunshine per day, with a high of 6.5 hours in August and a low of 4.6 hours in December.[23]

Net metering, the ability to connect renewable power generating systems directly to the grid, and receive a retail credit for power produced and supplied to the grid, has dramatically increased the market for grid-connected photovoltaics. Generation companies are beginning to incorporate PV as part of larger generation projects to achieve mandated renewable portfolio standards. Sempra Energy Resources installed a 100-kW system at their new Eldorado combined-cycle power plant in Nevada.

Residential-scale applications, in particular, have experienced a dramatic increase in use over the past several years, increasing from 11 in 2000 (29 kW) to 270 in 2001 (836 kW).[24] As of mid-May 2002, there are 119 projects representing 402 kW. At least four major residential builders offer solar as an option for new homes in San Diego.

As a result of AB 29X, the net metering limitation was increased from 10 kWs to 1 MW in April 2001. This, combined with enhanced incentives, education and promotion through the DOE's Million Solar Roofs[25] and the CPUC San Diego Self-Generation Program,[26] more businesses are beginning to consider PV. Larger systems are now coming on-line in increasing numbers.[27] One 137 kW system was installed in 2000 in Carlsbad, and several projects in the 750-kW to 1-MW range will be installed within a year's timeframe.

5.5.4.1 Potential for Photovoltaics in the San Diego Region

Photovoltaics could play a significant role in regional energy planning. Potential market penetration depends largely on module prices, utility electricity prices and the existence of government incentives. Assuming all funds are allocated through the CPUC Self-Generation program administered by SDREO, the region will have deployed about 8 MW of solar by the end of 2004.

Among the most promising markets for photovoltaics include large commercial and industrial customers and new home construction. The C&I segment is attractive because multiple government incentives make systems cost-effective.

The new home construction market also can be cost-effective due to long-term mortgage financing, bulk purchases, standard installations and systems. The San Diego Association of Governments estimates that the San Diego region will add approximately 180,000 new single-family homes by 2010.[28] If 10 percent of projected new homes included a 2-kW photovoltaic system, 36 MW of renewable capacity would be added to the region. Installing photovoltaics in new home construction could help to meet the growing demand of the region. The city of San Diego noted that year around PV only provides above 20% o fits rated capacity in San Diego.

While the new home construction market is very attractive, policies to mandate installation of photovoltaics and other solar equipment might be short sighted, however, policies to promote pre-wiring new homes may be appropriate.[29]

Another promising market segment includes local governments and public agencies. There is strong political support to install photovoltaics on public agency facilities, including schools and government

[23] Solar Radiation Data Manual for Flat-Plate and Concentrating Collectors, NREL. Golden, CO.
[24] SDG&E.
[25] SDREO partnered with DOE in 1999 setting a goal of deploying 20,000 solar roofs by 2010.
[26] This program is administered by the SDREO in the San Diego region. See www.sdenergy.org/selfgen.
[27] SDG&E notes that one large PV system is installed, one is in feasibility study, and no known projects planned as of 12/8/02. Projects not known at this time may not be installed in a year's time.
[28] 2000 Cities/County Forecast Table 2, Total Housing Units by Jurisdiction and Sphere of influence. San Diego Association of Governments, February 1999.
[29] Similar to existing codes that require pre-plumbing for solar water heating in the City of Carlsbad.

buildings. The inability to receive the tax benefits has been the most significant barrier to increased deployment in this sector.

Several innovative strategies could enable public agencies as well as commercial and residential customers to install photovoltaics. Large volume and aggregated purchases is one strategy to reduce prices. The Sacramento Municipal Utility District (SMUD) has successfully purchased large volumes of photovoltaic modules at relatively reduced prices. The California Conservation and Power Finance Authority (CPA) is also exploring the possibility of entering into large volume contracts with photovoltaic equipment suppliers and systems integrators. Partnering with the CPA on such a program presents opportunity for a regional organization that could aggregate such purchases.

Another strategy is to develop financing mechanisms for both public agencies and businesses. Currently, several companies are offering third-party financing arrangements for a non-profit business to purchase, install, maintain and own a photovoltaic system. The company then sells the solar-generated power to the "host" at a percent discount to below utility rates.[30] This could enable public agencies to install photovoltaics on facilities with no up-front capital costs.

The CPA also is developing financing instruments that could allow public agencies and potentially businesses access to low interest rates.

In fall 2001, voters in the City of San Francisco approved a ballot measure enabling the City to issue revenue bonds for the purchase and installation of energy efficiency, wind and photovoltaics. The City will service the bond debt with the energy savings realized through the energy projects. This is another strategy to deploy large amounts of photovoltaics, which could reduce costs, which should be considered at a regional level.

A final consideration is that local county taxing authorities can as part of property tax collections consider billing customers for investments in photovoltaics and the revenue recovery can be treated as an amortized investment.

5.5.4.2 Summary: Photovoltaics

PV represents a strong opportunity for the San Diego region to establish some level of sustainable energy diversity. Substantial cost reductions are anticipated through increased module production and aggregated purchasing strategies. This study projects that PV could economically represents between 230 and 865 MW of capability over the next 30 years. The absence of government incentives could dramatically curtail market penetration of photovoltaics, however. Continued tax credits, incentives and developer support will be needed.

5.6 Fuel Cells

While SDG&E installed and operated a 250-kW prototype fuel cell in 1997, no stationary fuel cells are currently operational in the San Diego region. However, fuel cells hold long-term promise of generating electricity efficiently with minimal pollution. At over $5,500 per kilowatt (installed), fuel cells are still too expensive for the residential market and have been applied mostly in limited commercial and industrial applications. Some developers are hoping to reduce the high capital costs down to $1,500 per kilowatt by late-2005. That would cost an average homeowner about 10 cents per kilowatt-hour for the five-year life of the system.

The industry also has been struggling with resolving technology issues, most significantly, the longevity of the fuel, cell stack, which is an expensive component of the system.

Due to the uncertainty in the timing and the resolution of these issues, and the development of the market, it is not clear whether fuel cells will become a significant resource in the near-term. This study anticipates that remaining technological issues will be resolved in the near-term, and prices will be reduced to the extent that they become competitive in the medium-term (2010 to 2015).

[30] Alten Energy and Solar Commercial Roofing are two companies offering third-party financing at discounts of 10 to 20 percent.

The U.S Navy will host one-year field tests of up to nine 5-kW PlugPower fuel cells at Naval Base Coronado and Naval Base Point Loma. These demonstrations should provide valuable information on the performance and feasibility of fuel cells for the residential market.

5.6.1 Fuel Cell Potential

The future market penetration of fuel cells is difficult to determine. Future deployment of fuel cells will depend on technological advances and the cost of natural gas and electricity. While fuel cells hold great promise for a transition to a hydrogen economy, currently the potential for fuel cell deployment in the region is relatively low in the next 5 to 10 years.

5.6.2 Summary: Fuel Cells

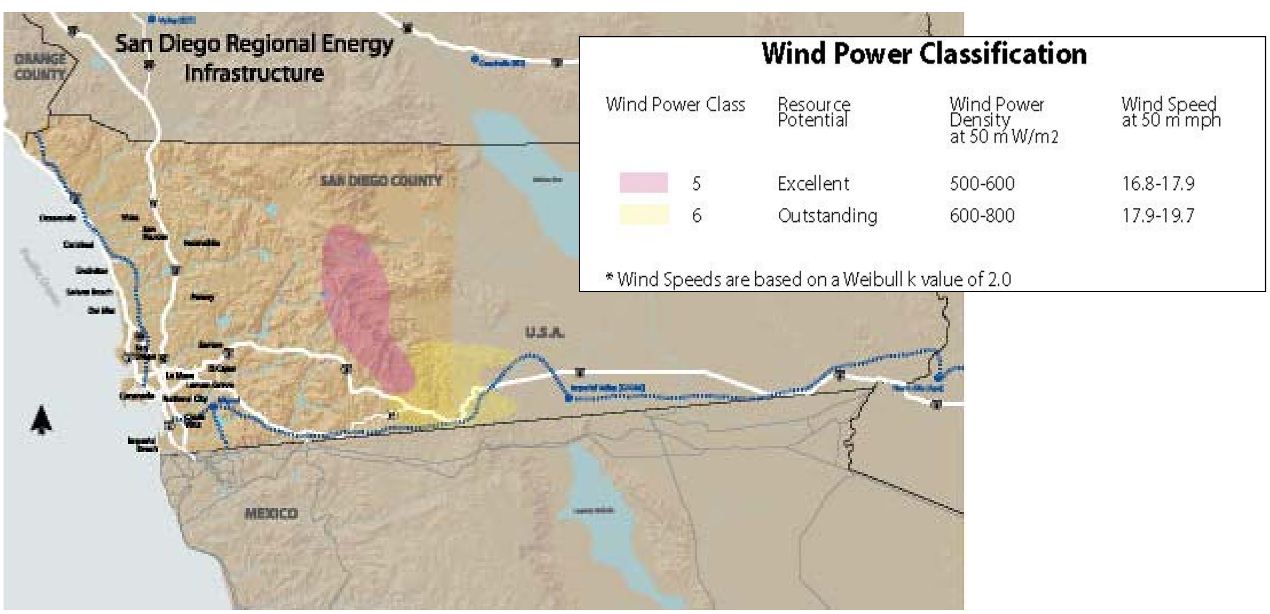
This study projects that fuel cells could represent as much as 15 to 70 MW of service by 2030. This estimate is highly speculative due to the uncertainties about the technology and its cost. It is not anticipated that the cost of fuel cells will drop quickly and suddenly as some studies project. Fuel cell advancements will not start reaching technical and economic efficiency needed for higher market acceptance until around 2020 and beyond. Currently, fuel cells are the least attractive DG technology available from the standpoint of economics.

5.7 Renewable Energy Technologies

5.7.1 Wind

There are six grid-connected wind systems installed in San Diego County for a total capacity of 14.5 kW. The San Diego region has limited wind resources. Ocean breezes prevalent in the coastal range are not strong enough for consistent wind power production. However, some potential exists in the mountains of East County. Figure 5-5 shows a wind map for San Diego County. Wind energy resources are characterized by wind power density classes, ranging from Class 1 to Class 7 (low to high). Good wind resources—Class 3 and above—have an average annual wind speed of at least 13 miles per hour. The National Renewable Energy Lab has developed a wind resource map for Southern California, which indicates several East County regions with wind resources of Class 3 and above. On some occasions during Santa Ana conditions, east county winds can exceed 25 mph. Some of the ideal wind conditions, however, are located in national forests and the deployment of this resource may be limited.

Figure 5-5. Wind Speeds By Location in San Diego County



Source: Wind Energy Resource Atlas of the United States, DOE/CH 10093-4, October 1986

Large-scale wind power systems need a significant amount of unobstructed property area for the turbine towers and capture of wind. San Diego County has specific zoning regulations for wind turbines, which include setback requirements and tower height restrictions.

Currently, ideal San Diego region wind power locations are limited by availability of adequate electricity transmission capacity. With these inherent limitations, there are few viable large-scale applications for wind power in San Diego County. However, East County business and homeowners in Class 3 and above areas could benefit from small-scale wind power to offset part or all their energy needs through self-generation.

5.7.2 Potential for Wind

No wind farms are currently sited in San Diego County. There are significant wind resources (in excess of 500-MW potential)[31] in eastern San Diego County in the vicinity of the Laguna and Jacumba Mountains, which have Class 6 and Class 5 winds, respectively. The major barrier to tapping this resource is the lack of adequate transmission infrastructure to transport the power to the grid.[32] Even more wind resources are available in Northern Baja California. Estimates are well in excess of 500 MW. The closest wind farm development is north of San Diego County in the San Gorgonio Pass, west of Palm Springs, which totals 421.1 MW of wind capacity and generated 805 MWh in 1998.[33]

The city of San Diego rightfully points out that there are local siting issues that exist. These include bird kills, noise, and aesthetics.

5.7.3 Summary: Wind

Contrary to general opinions, wind energy has the potential of being a significant resource meeting San Diego County's energy requirements. Development of these resources could be made more attractive by leveraging green ticket markets that are sold to entities that need to achieve certain levels of renewable energy generation to meet renewable portfolio standards. Wind energy potential ranging from 8 MW to in excess of 500 MW is possible over the next 30 years (more if further development of available wind resources in Baja California and east and north of San Diego County are considered).

It should also be noted that wind energy capacity availability is highly variable and uncertain. The California ISO noted in its Summer 2002 report that Wind resources in the Sate of California vary from 100 to 1,200 MW during peak hours. The availability factor is assumed for resource planning purposes to be about 20 percent.

The development of wind resources has largely been supported by a 1.5 cent per kWh federal wind energy Production Tax Credit (PTC), which was first enacted in 1992.

5.8 Solar Water Heating

No summary data of total installed pool or DHW units exists for the region although through anecdotal evidence, historically, this has been the best market for renewables, in particular, for pools. In addition, increases in natural gas prices have significantly increased the deployment of pool and DHW solar systems in San Diego.

Solar water heating is typically not viewed as a distributed generation technology because it does not generate electricity. However, it can offset both electric and natural gas consumption and should be considered a valuable energy resource in the region. Based on data from the Solar Rating and

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[31] Confidential conversation with industry sources (potential developers).

[32] Conversations with wind developers indicated that a study was recently done by SDG&E that indicated that a 28-mile line extension would be required to tie this wind resource into the local grid. The cost of this transmission line could exceed $20 million.

[33] American Wind Energy Association. 2002

Certification Corporation, a typical solar water heating system generates the equivalent of 3,400 kWh annually.[34]

More than one-half million solar hot water systems have been installed in the United States, mostly on single-family homes. The majority of these systems are used to heat swimming pools. Government incentives available from the mid-1970s to the mid-1980s led to a significant increase in the number of solar water heating systems installed. Since that time, overall installations have dwindled but there are significant increases among some applications.

In 2001, 33,000 new solar pool heating systems were installed in the United States in 2001.[35] According to the Florida Solar Energy Center (FSEC), the energy output of this quantity of solar systems translates into an electrical generating facility of approximately 594 MW.[36] Approximately 10,000 new systems were installed in California. More than 1,000 systems were installed in San Diego County during 2001.[37]

Solar water heaters for domestic use comprise a smaller segment of the market. There are no data available on the current stock of installed systems in the San Diego region. A notable project in the region is the Shea Homes High Performance Home project located in Scripps Highland. Shea Homes is installing solar water heaters on 397 homes as part of an energy-efficiency project that includes both solar water heaters and photovoltaics.

5.8.1 Potential for Solar Water Heating

Tremendous potential exists in San Diego County to deploy solar water heating systems in many segments of the market. As mentioned above solar pool heaters are the most cost-effective and widely used application. Commercial and institutional swimming pools in the region are a natural market for solar pool heating systems. In addition, pools in schools, parks, hotels, and apartment complexes also represent significant market opportunity.

As is the case with photovoltaics, the new home construction market is a significant opportunity to deploy solar water heaters for domestic use. Additionally, programs tied to reroofing of existing homes should be considered. However, mandatory programs may not be the most productive method to increase deployment. Providing incentives could be a more effective way to motivate customers to consider solar water heaters.

In September 2000, Governor Davis signed Senate Bill 1345 that provides funding for solar water-heating systems as well as distributed generation systems. The California Energy Commission is administering the Solar and Distributed Generation Grant Program.[38] The program provides $750 rebates for solar domestic water heaters and $250 for pool heaters. Since the program requires a building permit, many pool installations—which do not typically require a permit—have not used the $250 rebate because the time and cost for a permit is roughly equivalent to the rebate. Domestic solar water heating on the other hand has benefited from the program. The program is not currently funded for fiscal year 2003. The record budget deficit could make reauthorization of the program difficult.

[34] *Solar Thermal Collector Energy Output*. Solar Rating & Certification Corporation.

[35] The Solar Rating and Certification Corporation was established in 1980 to administer a certification, rating, and labeling program for solar collectors and a similar program for complete solar water and swimming pool heating systems.

[36] Estimates bases on an average of 1,000 Btu per square foot per day and an average of 5 hours per day for 5 months per year.

[37] Based on its relative size, SDG&E's territory typically represents ~6 to 7 percent of statewide energy calculations. A 10-percent factor was used here to reflect a higher rate of pool heating systems in southern California.

[38] See http://www.consumerenergycenter.org/solaranddg/index.html.

5.8.2 Summary: Solar Water Heating

Solar water heating represents a significant opportunity to diversify the regional energy power mix. Current incentives make this technology attractive. Paybacks are still somewhat longer than other conservation measures.

5.9 Geothermal

Even though geothermal is the largest source of renewable energy in California, There are no geothermal power generation plants in San Diego County. Much of the thermal energy in the region is located to the east and south of San Diego County.[39]

5.9.1 Potential for Geothermal

Imperial County has vast geothermal energy in deep thermal deposits located at Heber and East Mesa. One plant at Heber was developed by SDG&E in the 1980s. EIA energy resource maps indicate some projects of more than 1 MW on the California-Mexico border, however, none within San Diego County. One of the primary barriers to accessing these resources is the initial capital investment required to drill exploratory wells, which can cost between $1–2 million each. Better assessment and location of geothermal resources are the subject of research currently underway by the CEC and DOE.

5.9.2 Summary: Geothermal

Significant opportunities exist for developing geothermal resources in Imperial County and in Northern Baja. While these resources are not located in San Diego County, the potential exists for partnering with Imperial Irrigation District or CFE in Mexico to develop these resources to improve fuel diversity in the region. Geothermal is estimated to increase from 80 to 300 MW over the next 30 years (in Imperial County and Baja California).[40]

5.9.3 SDG&E and Renewable Interest Comments on Renewable Potential Estimates

SDG&E commented in its review of the final REIS draft that the CEC report, Renewable Energy Report (November 2001), that interest in renewable energy systems is quite low, primarily due to cost considerations. SAIC feels that the capital cost curve over the next 10 to 15 years will be the major factor affecting the use of distributed renewable systems. SAIC used detailed cost curves from its work with DOE/NREL and these were used as the basis of the penetration estimates. Codes and incentives will also be important. Other commenters felt that the SAIC estimates are too low.

5.10 Effective Market Potential of DG in the San Diego Region

DG can play an important role in energy planning in the San Diego region.

Potential exists for additional market penetration of DG technologies in the San Diego region. Table 5-10 presents an estimate of the market potential for distributed resources. The numbers shown are cumulative over time for low-, medium-, and high-growth scenarios. The estimates are based on national and state estimates and ratios, current penetration trends in San Diego County, and growth rates and maturity development rates of the technologies.

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[39] Sifford, Alex and Gordon Bloomquist. *Geothermal Electric Power Production in the United States: A Survey and Update for 1995-1999*. Geothermal Resources Council Transactions, Vol. 24, September 24-27, 2000.

[40] These resources are not really distributed generation resources, but still a significant form of renewable resource.

Table 5-10. Estimates of Effective Incremental Market Potential For DG (in MW)

Scenario	DG Technology	2006	2010	2020	2030
Low	CHP/DG	250	360	800	1250
	PV	6	12	40	175
	Landfill	4	10	20	30
	Geothermal	15	40	60	80
	Fuel Cells	2	5	8	15
	Wind	80	200	400	600
Medium	CHP/DG	360	650	1200	1600
	PV	10	15	75	225
	Landfill	6	12	40	75
	Geothermal	35	100	125	200
	Fuel Cells	5	20	30	40
	Wind	100	300	500	700
High	CHP/DG	500	800	1400	1765
	PV	30	60	120	275
	Landfill	8	15	50	75
	Geothermal	40	150	200	300
	Fuel Cells	10	30	50	70
	Wind	250	400	600	800
Total	Low	357	627	1328	2150
	DG Non-Renewable	250	360	800	1250
	DG - Renewable	107	267	528	900
	Medium	516	1097	1970	2840
	DG Non-Renewable	360	650	1200	1600
	DG - Renewable	156	447	770	1240
	High	838	1455	2420	3285
	DG Non-Renewable	500	800	1400	1765
	DG - Renewable	338	655	1020	1520

5.11 Potential Customer Benefits

- **Reliability** – Commercial and industrial customers are increasingly demanding reliable, high-quality power. Many industries require “nine nines” (99.9999999 percent) of reliability. This translates into less than 1 second of outages per year. DG can be a strategy to ensure power reliability. Customer acceptance of distributed resources in the future may be driven largely by concerns for reliability.
- **Peak Demand Reduction** – DG technologies can help reduce customer peak demand and consumption. Currently, a commercial customer on the AL-TOU tariff would pay a $0.12/kWh charge for peak consumption, a $10/kW peak demand charge and a $6/kW non-coincident demand charge for the highest demand registered at any time, which potentially could occur on peak.[41] Innovative strategies of integrating DG technologies with demand reduction strategies and energy management systems can increase demand reductions.
- **Choice in the Absence of Direct Access** – CPUC Decision 02-04-052,[42] approved April 2002, eliminated the option for electricity customers to purchase power from energy providers other than the local IOU (e.g., Green Mountain, Commonwealth Energy). DG provides

[41] SDG&E Tariff Book, http://www.sdge.com/tariff/.
[42] Interim Decision Moving the Proceedings On Direct Access Cost Responsibility Surcharges From A.00-11-038 ET AL. TO R.02-01-011 or Subsequent Proceeding, CPUC, April 2002.

customers choice and control over their energy planning in the absence of alternative energy service providers.

- **Hedge Against Price Volatility** – DG can provide large load customers a hedge against future volatile prices and an option for local supply when market or service conditions warrant it.

5.12 Other Regional Benefits

- **Power Generation Diversity to Mitigate Market Risk** – If electric wholesale prices are more volatile and much higher than the cost of natural gas to produce the power, using DG plants to produce additional electricity for the market is a very attractive option. However, there is much uncertainty as to how many hours per year market conditions will exist.
- **Avoided Capacity Costs from Grid-based Power Supply Options** – Analysis of the WSCC and San Diego region found capacity values starting at the $100/kW-yr level in 2002 and in some cases approaching $150/kW-year in 2002 for the capacity constrained scenario. DG units from purely an economic perspective, not counting service reliability, become very attractive at costs of $75/kW-year and above. In addition, over the 30-year study period there will be occasions of intermittent price volatility due to the boom and bust cycles of power plant development and load constrained pockets.[43] Future capacity values will rise more than $100/kW-yr (and this may happen as early as this summer for the next 2 years) and this suggests that all customers with sizeable process and large facility infrastructure load requirements consider DG as a hedge to higher future capacity prices and for additional reliability. The future will also involve more interruptible capacity and demand bid programs.
- **DG Impact on Air Quality** – By increasing the efficiency of energy use through renewable technologies and CHP applications, DG can significantly reduce emissions of criteria pollutants and greenhouse gases.[44] In addition, siting large-scale centralized power plants could be difficult in the San Diego region due to limited emission credits.
- **Resource Efficiency** – While future central station plants will generate electricity more efficiently than the 30- to 35-percent average rate through the late 1990s, DG installations with proper thermal/electric balance have design efficiencies of 80 to 90 percent and will still result in significant overall energy savings. On-site use of DG also reduces transmission and distribution system line losses to zero from typical central unit line losses of 4 to 12 percent.[45]
- **Energy System Security** – Decentralized DG is less susceptible to attacks and sabotage than centralized power plants. Damage to a centralized power plant could cause widespread disruptions.
- **Economic Development** – It has been reported that retaining a dollar in the local economy can have a multiplier effect that is as much as 8 times. Using locally supported DG initiatives, including leveraging the use of local DG resource firms can help create or maintain jobs, and economize energy prices which have a major burden on local businesses. Every effort should be made to use life cycle costing principals to screen and evaluate energy development options, including recognizing the advantages that some smaller scale energy technology may have more favorable impacts on the local economy than others.
- **Added Reserve Capacity** – DG can add to the state and regional need for additional reserve capacity. Adequate reserve capacities contribute to price stability by lowering reliance on last-minute spot market power purchases.

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[43] Note: the State of California may be developing a policy to avoid such cycles by instituting capacity credits and using the California Power Authority and local utilities to generate more power on a cost basis. Also, the power industry and financial markets may be doing their own “self correcting.”
[44] Market Assessment of Combined Heat and Power in the State of California, California Energy Commission, December 1999.
[45] Market Assessment of Combined Heat and Power in the State of California, California Energy Commission. December 1999.

- Many DG units can "back start."
- **Reduced Reliance on Imported Power** – Increasing energy supply by increasing DG capacity can ensure that sufficient regional generating capability exists in the region, thereby reducing reliance on imported power, which is now dependent on limited transmission entering the county. It is prudent to have a balance of grid and local capacity and electric energy capability. Local DG investments should be considered as insurance when larger regional power markets become volatile and capacity is in short supply and or cost avoidance and damage avoidance when power supply is interrupted.

5.13 Potential Utility Benefits

In the current restructured electric industry in California, distributed generation options can offer grid support to the distribution utility

- **Incremental System Capacity Additions** – The construction and permitting period for both centralized power plants and transmission and distribution upgrades is on the order of 3 to 7 years. Adding localized DG capacity in segments of the T&D system that are most constrained can be achieved more quickly and potentially is more cost effective.
- **Avoid or Defer Infrastructure Investments** – Adding DG in capacity constrained areas could defer and possibly obviate the long lead-time and expense of infrastructure expansions, particularly new transmission investments.[46]
- **Lower T&D Losses** – DG technologies are located at or near the site of consumption and therefore do not incur line losses associated with long transmission lines and the distribution process.
- **Increased Gas Flows** – Increased DG deployment also could represents improved gas flow for gas utilities. Most DG technologies combust natural gas to create electricity.
- Relieve Grid Capacity Strains – DG is a viable mechanism to relieve capacity constrained segments of the utility transmission and distribution system.

5.14 Economic Development Impacts of Energy Efficiency and Distributed Generation

Energy fuels the growth of San Diego's economy. The economy, in turn, directly employs thousands of workers and each year provides billions of dollars in economic activity and millions of dollars in taxes and other revenues to local government.[47]

The availability of lower-cost energy will become increasingly important as long as the region has the goal of expanding its economic engine built on high technology, biotechnology, telecommunications and other economic sectors. These sectors are important to the region's economic prosperity because they provide relatively high wages, and bring new dollars into the region's economy through exports.

In evaluating the impacts of energy efficiency and DG investment decisions on the economy and economic development, several factors need to be considered, including:

- Total required investment in energy efficiency and DG
- The energy savings as a result of implementation of energy efficiency
- The retained energy dollars as a result of increased efficiency and customer-owned electricity generation in the region versus importing electricity

[46] The creation of demand response and demand bid programs are designed to address both emergency and economic dispatch and use of onsite generation when market conditions need this capacity.
[47] SDG&E rightfully pointed out that the REIS was not a transmission planning study and therefore these impacts are not proven.

- The potential incremental increase in revenues for companies offering energy efficiency/DG services and improvement in jobs in the County
- The potential multiplier effect from dollars that are retained in the County
- The impact of high costs and future price uncertainty on economic growth
- The opportunity of energy efficiency and clean generation technologies to fuel a new services cluster

As experienced over the past 2 years, high-energy prices can significantly dampen economic growth and consume limited disposable income. In 2000–2001, the region spent more than $6.4 billion on electricity and natural gas, roughly 3.4 percent of the region's $95 billion Gross Regional Product (GRP). Of this amount, more than $3.8 billion left the region's economy.[48] During the same time period, despite reducing our consumption, the region spent nearly $155 million more on electricity and natural gas[49] than it would have spent in 1999. The estimated increased costs of electricity and natural gas for the region from 2000 through 2006 is expected to exceed $7.7 billion.[50]

In addition, the opportunities that can be presented by capitalizing on this market are equally impressive. From 2002 through 2030, it is estimated the region will spend approximately $166 billion on electricity and natural gas. As the region learned from the last 2 years, the risks of not controlling these costs are very high. By improving electricity end-use efficiency by only 1 percent per year, the region could save more than $1.3 billion through 2030 (cumulative). A slightly more aggressive efficiency target of improving our efficiency by 2 percent per year saves more than $2.7 billion. Eliminating growth in electricity end-use would save nearly $4.5 billion. This would be accomplished through a variety of measures and pricing methods.

5.15 Potential Investment Impacts of Energy Efficiency, Demand Response and Distributed Generation on the Local Economy

Table 5-11 shows estimates of the level of investment in energy efficiency/demand response and distributed generation through 2030, along with the estimated employment and gross wages[51] to support these growing industry segments. The data in the table show a 5 to 1 investment return from energy efficiency and DG. For investing as much as $3.6 billion the community gets an economic benefit of $17.8 billion, under the medium scenario. Thousands of jobs would also be created in the community over the 30-year period.

Table 5-11. Summary of Economic Impacts of Demand Side and DG Options

Scenario	Energy Efficiency Investment ($ Million)	Distributed Generation Investment ($ Million)	Total Investment ($ Million)	Total Economic Impact[52] ($ Million)	Firms	Employment	Gross Wages ($1,000s)
					60	2,500	$ 95,000
Low	$ 632	$ 2,060	$ 2,692	$ 13,460	200	14,323	$ 931,000
Medium	$ 664	$ 2,490	$ 3,154	$ 15,770	300	17,176	$ 1,100,000
High	$ 850	$ 2,700	$ 3,550	$ 17,750	350	19,385	$ 1,260,000

[48] Assumes 59% of energy costs leave the economy, which is highly conservative. In some portions of the country, nearly 80 percent of energy expenditures leave the economy (Source: Skip Laitner, The Hidden Link: Energy and Economic Development, Urban Consortium Energy Task Force.

[49] Comparing actual expenditures to projected expenditures at historical prices inflated at historical rates.

[50] Likely to be a conservative estimate based on historical growth rates versus the 2001 and 2002 depressed levels of electricity consumption.

[51] Based on an estimate of 60 energy firms in 2002, averaging 42 employees per firm with average annual earnings of $38,000 per employee.

[52] Assume an economic multiplier effect of 5 to 1.

An example of the impacts of energy efficiency can be drawn from a recent energy efficiency program. In 2000, SDREO began implementing a program that installed energy efficient “cool” roofs on buildings. SDREO estimates that it will install more than 25 million square-feet of energy efficient roofing by the end of 2002.[53] Total program costs will be about $5 million; total investment of customers for the roofs (minus incentives) is approximately $37 million,[54] with an incremental investment of approximately $1.8 million (the premium for installing an energy efficient roof.[55]) Over the 10-year life of the roof (which is conservative), the energy savings are in excess of 24 million kWh and costs savings are in excess of $7.5 million.

Considering one element of the distributed generation projections of this Study illustrates the potential impacts of a solid DG-based strategy. For PV, the most costly of the technologies considered, to achieve the medium case estimate of 250 MW by 2030, the region would need to experience a 17 percent average growth in deployment of PV per year. If this strategy is pursued, the cumulative electricity costs savings through 2030 are in excess of $1 billion. Additional benefits include jobs to support the manufacturing, assembly and maintenance of the systems. These jobs are relatively high paying, and could be grown within the region.

Two key questions are raised from the perspective of the region’s approach to electricity and natural gas supply choices and the overall economy:

1. How can energy programs be developed to reduce the drain of energy dollars from the region?
2. How can the region better position itself through actions to lower energy costs and improve energy self-sufficiency such that energy costs are not an economic disadvantage, but an economic advantage?

In 1992, the Sacramento Municipal Utility District (SMUD) implemented a program to obtain as much as 650 megawatts of equivalent power capacity by the year 2000. According to a recent report published by the California State University, the program had the following results and impacts:

1. $59 million spent locally on energy efficiency measures
2. Avoided spending $45 million to purchase power from other regions
3. Increased regional income by $124 million, achieving an economic multiplier of 2.11
4. Created about 880 direct-effect jobs
5. Added $22 million to the area's wage-earning households.

Additional long-term benefits accrued to the region through lowered overhead or operating costs for participants (resulting from the continued energy savings of energy efficiency improvements over the 10 to 20-year life of the efficiency measure) and, therefore, increased disposable income. These energy dollars are more likely to remain in the local economy, creating an economic multiplier.[56]

5.16 Disadvantages of DG to the San Diego Region

While there are many advantages to deploying DG in the region, several disadvantages must be considered in determining its appropriate role. Disadvantages of DG include:

- **Dispatchability** – Many distributed generation technologies cannot easily dispatch power onto the grid when needed. This is particularly true for renewable technologies including photovoltaics and wind. The city of San Diego (MWWD) notes that it has a 1.2 MW digester gas peaking unit and other biogas fueled and geothermal systems that could be dispatched, if required.

[53] Not all of this roofing is located in San Diego County, but the program numbers will be used for this illustration.
[54] Based on an average of $1.50 per square foot.
[55] Based on an average of a 5-percent premium for energy efficient roofing materials.
[56] The American Council for an Energy-Efficient Economy, Energy Efficiency and Job Creation: The Employment and Income Benefits from Investing in Energy Conserving Technologies.

- **Coordination of DG Units for Grid Planning** – Many smaller decentralized power generation facilities could be more difficult to manage. This would be particularly true if individual generators who could produce more energy than needed to power a specific site put excess power into the grid. Fewer, larger generators are easier to manage and plan than many, smaller ones.
- **Gas Infrastructure Affects** – Increased reliance on natural gas-fired DG technologies could require infrastructure upgrades. A major limiting factor in considering widespread market penetration of natural-gas-fired distributed generation systems is proximity to natural gas mains. Some larger DG systems require high-pressure gas service. Access to a high-pressure line or the installation of a localized device to increase gas pressure is required. However, this additional cost of a fuel gas compressor is significant and can easily make the option not cost effective. To add a high pressure gas line to serve an on-site turbine for a gas generator, the cost may be as much as another $50,000 to $100,000 depending on the size of the unit and distance and size of the line.
- **Potential Effects on the Transmission and Distribution System** – While no evidence exists to verify the concern that a dramatic increase in DG technologies could affect the T&D system, the potential need for small-scale upgrades should be considered.
- **Still Need Permitting and Emission Offsets for Larger Units** – DG units will still have to meet clean air and emission permitting requirements and possible offsets. MWWD noted that some biogas plants are very cost-effective when compared to retail rates, if cost-effective designs are used.

5.16.1 Economics

Historically DG technologies have higher capital cost than combined-cycle gas turbine systems and other base load power supply options. Increased electricity and natural gas prices combined with declining DG equipment costs are making these technologies competitive with utility power.

5.16.2 Price of Energy

The main factor in determining whether DG applications are cost effective for customers is the cost of utility power and natural gas, along with the value placed on reliability. While both electricity and natural gas prices reached historic highs in 2000–2001, they have settled down to rates that are 30 to 40 percent pre-energy crisis levels. At current energy prices, some DG applications are very cost-effective (e.g., CHP) while most are marginally cost effective (e.g., solar PV with full tax advantages).

Green pricing programs that take into account the value of externalities, such as the environment, help make renewable compete on a more level playing field with fossil-fueled power. According to the National Renewable Energy Laboratory (NREL), as of January 2002, a total of 650 MW of new renewable energy capacity has been installed as a result of utility and competitive green pricing programs, and another 440 MW is expected to be installed in 2002. Of this total, 93 percent is wind, 4 percent is biomass, 1.7 percent is small hydro, 0.7 percent is geothermal, 0.6 percent is solar and 0.2 percent is landfill gas.[57] Green pricing programs have consumers pay a premium for purchasing green power, which can vary between 0.6 and 5.0 cents per kWh. Green power programs are currently offered in markets in 23 states. Public Service of Minnesota had such a program where 7 percent of its customers participate.

5.16.3 Regulatory Issues and Tariffs

The State of California is working toward a more coordinated energy efficiency, demand response and renewable energy strategy – even though there may be much uncertainty in direction on the market design for the State. Over the last several months there have been a number of significant developments occurring that will create significant opportunities for San Diego County in the future to

[57] Price, Jeff. The Production Tax Credit, PUF, May 15, 2002, p. 40.

realize its high potential for energy efficiency, demand response, renewables and DG. These events include the following:

- Recent CPUC approval of an OIR regarding the implementation of real time and dynamic pricing (See: http://38.144.192.166/efficiency/2002-06-07_en_banc/2002-06-07_TRANSCRIPT.PDF)
- The proposed 2005 CEC building code may require the incorporation of photovoltaics and that all new buildings be wired for real time meters and demand response thermostats
- The CPUC must approve any tariffs to support real time pricing and demand response programs.
  - For 2001-2003 the CPUC energy efficiency and conservation programs will total $424 million and result in 452 MW peak savings
  - Programs cover retrofits and renovations
  - Lighting and appliances
  - New construction
  - Comprehensive group development programs for universities and housing complexes
  - HVAC technologies
  - A total of $102 million is reserved for local project funding
  - A variety of demand response programs are supported (Over 1,300 MW of curtailable load is available)
  - The CPUC also grants funds for customers producing electricity on-site for up to 1 MW without exporting for sales. This program also provides higher grants for renewable generation options.
- The California Power Authority has access to capital and loans to support the installation of demand responsive equipment and loans
  - $30 million of tax exempt bonds for the purchase and installation of energy efficient projects or renewable and clean energy resources
  - Tax exempt loans to state and local public agency buyers of DG and efficiency equipment and services—minimum size is $2 million
  - A DG public procurement program for public agencies
  - Third party financing for DG
  - A demand reserves partnership program
  - Financing of TOU meters and communications technology.

Other proposed new state programs for which bills passed the California legislature and are awaiting gubernatorial approval include:

- SB 1038 which requires a renewable energy efficiency development program for the state to be submitted to the legislature
- SB 1038 would provide substantial new funds for the development of new renewable projects in California by amending the renewable resource trust fund
- AB 57 would require Procurement Plan be developed to achieve a 20% renewable portfolio and grow at a rate of 1% a year—provided sufficient funds are available. A risk management policy and program is also required to avoid price shocks.

5.16.4 Inability to Wheel Power Offsite

Currently customers cannot easily transfer power generated at a site with limited loads to another site with high loads. For example, the City of San Diego Environmental Services Department has conducted several feasibility studies to install up to 1 MW of photovoltaics at the closed Miramar Landfill. Under the current regulatory framework, the City could not transfer or exchange the excess power generated at the Miramar Landfill to its other facilities, which draw power from the local utility grid.

5.16.5 Interconnection

Rule 21, a standard interconnection agreement among the state's IOUs, facilitates the interconnection process for DG technologies,[58] and several other interconnection-related barriers still exist.

One may review the handbook on Rule 21 interconnection issues by visiting SDG&E's web page to understand the complexity of interconnection.

5.16.6 Net Metering

AB 1890 provided for net metering, which allows customers to connect a renewable energy generating system directly to the utility distribution and transmission grid and to receive retail credit for excess generation. This law enabled the grid-connected photovoltaics market in California and greatly improved the economics of renewable technologies.

Incorporated into the California Public Utilities Code as Section 2827, the original law allowed net metering for photovoltaic or wind systems up to 10 kW. This limited net metering to the residential and small commercial customers. In addition, the law stipulated that total net metered systems could not be more than 0.1 percent of peak demand of the local investor-owned utility. In San Diego this translated to a cap of approximately 3.8 MW of photovoltaics and wind.

In Spring 2001, Governor Davis signed into law AB 29X, which amended section 2827 of the California Public Utility Code to increase the system size limit to 1 MW, eliminate the 0.1 percent peak demand cap and exempted net metered customers from standby charges. These amendments will sunset on December 31, 2002.

The changes included in AB 29X were viewed as positive development for the deployment of renewable energy technologies, particularly photovoltaics. Reinstating both the 10-kW system size limit and the 0.1 percent peak demand cap on net metered systems could significantly reduce market penetration of photovoltaics in the San Diego region. This is especially true since the region currently has 1.6 MW of photovoltaics in operation as of May 2002 and an additional 2 MW were in development. At the current rate of deployment, photovoltaic installations in the San Diego region likely will reach the 4-MW mark in the next 1 to 2 years.

Additionally, if the provisions of AB 29X sunset at the end of 2002, customers that install photovoltaics will be required to pay standby charges. This could make many projects uneconomical.

5.16.7 Tariffs

- Schedule A-V1 was closed effective 10/01/02. It was replaced by AL-TOU-CP. Terms and conditions of AL-TOU-CP are slightly different than AV-1.

5.16.8 Departing Load Fee

The CPUC is conducting a proceeding[59] to consider establishing an exit fee for customers who either participates in direct access contracts or who generate a portion of their power onsite with distributed generation technology.

[58] See http://www.energy.ca.gov/distgen/interconnection/california_requirements.html.

Departing load fees are being considered mainly because the CA Department of Water and Resources (DWR) has purchased long-term power contracts and many experts believe that the burden for servicing the associated debt should be borne by all ratepayers. Customers who purchase power from a source other than DWR or generate a portion of their own power would pay no or a smaller portion of the debt, while those still purchasing their power from their local utility would shoulder a proportionally larger burden.

Many DG technologies are marginally cost-effective and departing load fees could significantly inhibit further market penetration.

5.16.9 Permitting

Two important areas of permitting exist for energy efficiency and DG—air emissions and local area permits for building and construction. What follows is a review of these permitting issues and requirements. The agencies potentially involved in DG siting approvals are the following:

- **Air District: Air quality permitting** – Primary area is the control of air pollution to protect public health. May have CEQA responsibility as lead agency or responsible agency. Compliance with federal and state Clean Air Act requirements jurisdiction defined by county limit or a group of counties comprising an air district.
- **Local planning department: Environmental assessment** – Primary areas are land use and zoning issues. May have CEQA responsibility as lead or responsible agency. Project impacts evaluated for conformance and environmental impacts. Noise impacts evaluated by this agency. Jurisdiction defined by city or county limit.
- **Building department: Building permit approvals** – Approvals issued for projects in conformance with building code requirements. Also ensures project design is consistent with industrial and worker safety. Jurisdiction typically defined by city or county limit.
- **Fire department: Fire protection and safety** – Approvals issued for projects in conformance with fire code requirements. May also be organization responsible for portions of environmental health-related requirements. Jurisdiction typically defined by city or county limit.
- **Environmental health: Public health and safety** – Approvals issued for projects in conformance with federal and state hazardous materials and waste management requirements. May also have responsibilities associated with fire and building code issues.
- **Jurisdiction defined by city or county limit: Water and wastewater district; public works** – Water supply and discharge. Approvals issued for allowable discharge to sewer system; evaluates waste streams that may enter various bodies of water (e.g., lakes, streams, bays, estuaries, coastal waters, etc.). Ensures compliance with storm water requirements. Project conformance with federal Clean Water Act and local water and wastewater quality requirements.

The potential obstacles for DG permitting remain the same obstacles as identified by the Energy Commission in its evaluation of the CEQA review, building permit and air permit streamlining process. Specifically, there is not uniformity and/or consistency among the different approval agencies within the same categorical areas. Delays in permitting are not necessarily driven by the unique nature of DG. Sempra Connections, the Sempra Energy subsidiary that works with customers to build onsite DG systems, reports that while a local permit for a microturbine may take 30 days, but permitting a small building enclosure may take up to 90 days or more. APCD tries to process permits within 90 days even though they have 180 days.

[59] See Administrative Law Judge's Ruling Clarifying Scope and Adjusting Hearing Schedule Relating to Departing Load Customer Issues, issued April 5, 2002 in A.00-11-038 et al.

5.17 Air Permits[60]

For regional Air Quality Managers, reducing emissions from electric generation is a key element in effort to achieve/maintain standards. The current focus by APCD is to require Best Available Retrofit Control Technology for upgrades of existing plants and installation of Best Available Control Technology (BACT) for new plants/facilities. BACT forecasted to reduce NOx from existing plants by 70 to 90 percent. Power plant emissions account for less than 1 percent of statewide total of reactive organic gasses (ROG), carbon monoxide, and particulate matter under ten microns (PM 10); less than 3 percent of oxides of nitrogen (NOx), and less than 5 percent of sulfur (SOx).

A recent report on DG potential in California stated the following regarding emissions and air quality:

- Economic potential for utility-owed peaking DG is substantial as they can provide peaking capacity at lower overall cost than traditional central generation.
- Base load DG does not currently compete economically with the wholesale market except for Combined Heat and Power (CHP).
- DG systems that capture heat can significantly improve the economics of DG projects; Report estimates that up to 15 percent of utility new load forecast could use CHP.
- According to San Diego APCD, unless DG projects zero or near-zero emission technologies, emission rates (pounds/mwh) are usually higher than new, large central power plants. Also, their emissions are nearer to ground level, which may result in greater impacts on ambient air quality conditions.
- DG has in many instances emission features that are much improved over the average electric generation technology in the market. When compared with the newest and most advanced generating plants, however, DG emission characteristics do not appear to be as attractive. MWWD reports that renewable DG and CHP with high efficiencies should compete favorably with combined cycle plants using a boiler to produce hot water, or using a flair from landfill gas.

The goal of environmental control agencies and the state of California is to ensure that DG emissions become comparable to the per kWh emissions levels of new central plants on an emissions per kWh basis by 2007.

A recent study performed by the Center for Clean Air Policy,[61] shows that on-site generation displaces a mix of other generators depending on the location and operating characteristics of the DG project. Because DG displaces a mix of new and existing generators with higher average emissions, the environmental outcome for DG is always positive.

The analysis described above shows that gas-based DG would actually be beneficial to air quality in most applications and locations. Based on this assessment, it is inappropriate to attempt to hold conventional DG technologies to the standard of well-controlled gas combined cycle projects. The primary result of such an approach will be that DG projects that could reduce emissions will be prevented from being installed and the environment will suffer. In light of these results, a better regulatory approach must be developed which is protective of the environment through the encouragement of beneficial DG technologies.

5.18 Local Building Permits

An important permitting hurdle exists for new DG projects at the local level. The primary local permit processes are conducted by multiple agencies, e.g., city and county governments, air districts. Obtaining approvals from various entities can be time-consuming and costly, as well as confusing to

[60] Source: 1999 Electricity Generations Emissions Report (EGER): A Report to the California Legislature as Directed by SB 1305. Prepared by CEC Staff. Presented for approval at the July 1999 business meeting of the CEC.
[61] "Clean Power, Clean Air and Brownfield Redevelopment", Catherine Morris, Center for Clean Air Policy.

project developers who are not well versed in the local government requirements and procedures and to agency personnel who are not knowledgeable regarding DG technologies. Consequently, the deployment of DG may be hindered because of the involved and costly permit processes. In order to overcome these obstacles, the permit process must be understood, and opportunities to reduce confusion and costs should be developed.

The levels of government involvement and review and approval obstacles were presented in the California Energy Commission December 2000 report, "Distributed Generation: CEQA Review and Permit Streamlining" (P700-00-019). The three permit processes identified by the Energy Commission included land-use approvals, building permits and air permits with particular emphasis on the requirements for approval and permits, as well as opportunities identified to streamline the California Environmental Quality Act (CEQA) review and permitting processes.

As a result of this effort, the Energy Commission Staff provided local governments with training, technical assistance, and guidance on the amended CEQA guidelines.

This approach enables the Energy Commission to maintain its neutrality regarding the acceptability of individual DG projects, while still facilitating DG project deployment.

The number of approvals locally will vary depending on project characteristics such as the size and complexity, geographic location, the extent of other infrastructure modifications (e.g., gas pipeline, distribution system, sewer connections), and potential environmental impacts of construction and operations.

The primary approvals that DG sources must obtain consist of the following:

- Local jurisdiction pre-construction and construction approvals
- Planning department land use and environmental assessment/review
- Building department review and approval of project design and engineering
- Air district approval for construction

Local distribution utility approval:

- Interconnection study
- Natural gas pipeline connection/supply

Local jurisdiction post-construction and operation approvals:

- Planning department and building department confirmation and inspection of installed DG source
- Air district confirmation that DG emissions meet emissions requirements

5.19 Role of Local Governments in Deploying DG

Public agencies at all levels play an important role in promoting DG technologies. Federal and state agencies are critical stakeholders in the DG deployment, however the below focuses on the role of local governments in deploying DG technologies.

5.20 Streamline Permitting for DG

The role of local governments is also critical to the future of distributed generation in California. Permitting of DG is most likely to be performed by local governments. As such, local governments will need access to information that will assist them in making these permitting decisions. Some local governments conduct DG-specific economic development activities. For example, several California jurisdictions—including San Carlos, San Diego, Long Beach, San Francisco, Santa Monica, Santa

Rosa and San Jose—comprise the Urban Consortium Energy Task Force, whose current agenda includes DG building permit streamlining.[62]

5.21 Identify and Address Barriers

Local governments can review their permitting and siting procedures to identify potential barriers to DG installations. Local governments in cooperation with the SDREO can develop model policies in area concerning DG technologies.

5.22 DG Demonstration

Local government facilities offer ideal settings for demonstrating DG technology, because public institutions can tolerate longer payback periods than private businesses and their demonstration sites are visible to local residents and businesses. A number of California cities and counties are now installing DG projects, with assistance from the Local Government Commission and the Energy Commission."[63]

5.23 Revenue Bonds to Procure DG

Local governments have bonding authority that can be used to finance energy projects including energy efficiency and distributed generation in public building. Voters in the City of San Francisco in November 2001 approved a $100-million revenue bond to conduct energy efficiency upgrades and install photovoltaic and wind power generation equipment. The energy savings from the financed projects will fund the bond payments unlike general obligation bonds, which are typically paid for through tax revenues.

5.24 CA Power Authority[64]

Local governments in the region could access tools and programs currently in development by the California Power and Conservation Financing Authority (CPA). The CPA plans to assemble master contracts for DG technologies including fuel cells and photovoltaics. Local governments could use these contracts to procure DG technologies and services much like they currently can participate in state purchases of other equipment such as vehicles. Also, the CPA is developing several financing programs that could facilitate the purchase of DG technologies. For example, the CPA recently made available $30 million of tax exempt Industrial Development Bonds to provide below-market rate loans to manufacturing companies producing or choosing to install clean energy solutions in California.

5.25 Recommended Actions for Promoting Energy Efficiency, Demand Response, and Expanding DG/Renewables

5.25.1 Energy Efficiency and Demand Response

- All residential and small business customers should be on time-of-use meters and tariffs, and customers of 200 kW and higher should be encouraged to be on real-time pricing tariffs once the CPUC has agreed how to value wholesale electricity by time which is essential for RTP to work.
- A strong regional policy supporting aggressive conservation and demand management should be encouraged in the County.
- Improved coordination and collaboration is needed between SDREO and other energy service providers, including SDG&E

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[62] Distributed Generation Strategic Plan (Draft), publication # 700-02-002D, May 2002. CEC.
[63] Draft Distributed Generation Strategic Plan. California Energy Commission, 2002.
[64] See http://www.capowerauthority.ca.gov/

- The region should consider condition-of-sale regulations to upgrade existing buildings to meet minimum efficiency levels.
- Local stakeholders should be better organized to influence regulatory bodies (e.g., CPUC, CPA, CEC) on allocation and spending of region's public benefit funds.
- A demand-side strategies task force should be formed to enhance coordination of programs, gaining cohesive regional positions on key issues, and to enhance access to critical data to evaluate cost-effectiveness of options. Sub-committees should address specific areas of distributed generation, demand response and energy efficiency.
- The region should closely monitor and track the results of resource development and load management initiatives, seek to achieve continuous improvement in these programs and report the results to the public.
- Create a market based demand response capacity program
- Tax incentives and other economic incentives should be used to lure energy efficiency and distributed resource firms into the region.
- Intensity of support for interruptible capacity programs should vary in intensity depending on market conditions.
- Encourage the CEC and CPUC to continue to support cost-effective energy efficiency through existing public-good funding.
- Consider using more peak/off-peak sensitive rate designs, with large delta's.

5.25.2 DG/Renewables

- The region should consider committing to achieving 30 percent of available demand requirements through DR resources by 2030.
- There is a need to streamline permitting for DG applications in the county.
- If the region creates a joint action agency, serious consideration should be given to the support of a joint development of renewable energy projects in and outside the region for energy used in the region.
- An organized regional corporate pledge and commitment program should be developed to support strong commitment to regional DR and green energy development.
- SDREO should develop a help desk and clearinghouse to help investors in renewable and clean energy technologies. A more active DG coalition should be formed to address the exit fee issue.
- A renewable energy economic development program should occur whereby producers and suppliers of clean energy are encouraged to locate in the county.
- SDREO should develop a renewable resource index and tracking system.
- Developmental support for renewable resources in Northern Baja California and Tijuana areas should considered. A joint plan should be developed to achieve a renewable goal for the entire bi-national metropolitan area.
- Take advantage of the CPA desire to add more reserve capacity in California—potentially new sources of capital may be available.
- Create economic development zones that offer advanced power services;
- Form a San Diego DG Working Group comprised of industry experts, local governments and utility representatives.
- Explore opportunities to aggregate DG equipment purchases.

- Use local government organizations to demonstrate renewable technologies and encourage other businesses to do the same.
- Encourage the CEC and CPUC to continue to support cost-effective distributed generation and renewables through existing public-good funding.
- Have renewable and CHP included as part of the PUC's new project design incentives programs.